

Minutes of the Technical Review Committee

Meeting of August 10, 1992

Recorded by Philip Allard

Attendance:

Committee Members:

Paul Anderson (PA)
Craig Forster (CF)
Jim Kohler (JK)
Diane Neilson (DN)
Hugh Coltharp (HC)
Stanley Plaisier (SP)
Ton Netelbeek (TN)

BLM Representatives:

Phil Allard (PhA)
Deane Zeller (DZ)

U.S.G.S. Representatives:

Lee Case (LC)
Jim Mason (JM)
Geoff Freethy (GF)
Joe Gates (JG)

Preliminary Meeting:

The meeting was held in the conference room of the Salt Lake District Office, Bureau of Land Management. The representatives of the U.S.G.S. were not present during the premeeting. DZ was not present during parts of the meeting because he had to take several calls.

1. PA called the meeting to order at 8:30 am. PA presented the minutes from the June meeting. HC pointed out a couple of typographic errors. SP said that the last sentence of item two, post meeting section, needed to be struck because a statement was attributed to him which he did not make. PA moved that the minutes be accepted subject to the corrections identified. The motion passed and the minutes were accepted as modified.

2. PA introduced the report from the U.S.G.S. and said that the most significant component was the discussion of the pump test. The G.S. seems to be looking for a recommendation from the committee on whether to redo the test. It is not clear that if they redo the test that they will get more data. CF stated that he was not sure of the benefits. U.S.G.S. will get additional data but is it worth the expense? They have learned from the test that was conducted even though the data may not be quantitative. DN asked what numbers would be used in the computer model if the pump test numbers aren't used. PA suggested that the core numbers for vertical transmissivity would be used, but there is a 5 order of magnitude difference between the pump test values and the core

analysis numbers because of the fracture controlled permeability of the material which is not represented by the core analysis. DN stated that this should be an area of concern. CF said that it might be possible for the computer model to be run before the decision on rerunning the pump test would need to be made. If this were possible the results of the model could be used guide the decision to rerun the pump test. PA suggested that an alternative would be to drill a new production well that avoided the fracturing that effected the production well in the test. You still may get a number substantially different that the core test and are left with the problem of which number to use. SP asked if the water level in the alluvial fan has dropped enough to create a gradient from the Salt Flats to the alluvial fan? Is the boundary condition here of sufficient importance to warrant the expense of rerunning the test? Have you (PA, CF) seen the data to indicate if data in this area are needed? Is there recharge to the alluvial fan aquifer from the shallow system? CF stated that it was time to ask for an update on U.S.G.S.'s understanding of the system. This may save time since the TRC won't have to rehash the same issues. Lines showed that there was a gradient from the Salt Flats to the alluvial fan. SP said that if the gradient is to the north then the salt could be going in several directions so it may be critical to rerun the test. PA stated that the original objective was to establish the relationship between the brine aquifer and the fan, but the model hasn't progressed to the point where it can be used to drive data collection. A good recommendation would be to make some model runs to see how sensitive the model is to the pump test derived data and use that to guide further discussion.

3. TN asked if the U.S.G.S. does additional work on the pump test will something else drop out of the study. If this happens, what will it be and how important is it? PA speculated that the pond migration issue may be the one thing dropped out.

4. SP stated that he had been unable to get to the U.S.G.S. office to review drilling data. PA said this may not be important anymore because U.S.G.S. may have completed the planned drilling.

At this point the premeeting concluded and the representatives of the U.S.G.S. were invited into the meeting.

Main Meeting

1. PA thanked the U.S.G.S. for the lead time provided to the TRC for the review of the progress report. JM then said that they had completed the mass water level measurements, but the maps aren't drawn because new cadastral survey data revised the elevations of some of the wells by as much as 2 feet. All of the topographic information may not be available until fall, especially on the new wells. March and July are the two water level measurements so far this year. At the end of June the drilling crew from Denver came out to follow through on some ideas developed by Blair Jones. They collected core from directly below the salt crust. Samples were sent to Reston. They have taken fluids from pores and also

collected about 10 feet of core from the 45' to 55' level below the salt crust. Blair Jones will analyze the pore fluids, but clay mineralogy will be done by the University of Wisconsin. Tim Lowenstien of SUNY, Binghamton, is interested in looking at oxygen and deuterium in fluid inclusions in the salt crust to see if he can determine the crystallization history of the crust; however, they have not yet been successful in getting an undisturbed core of the crust. JM asked SP if Bingham Engineering had ever cored the salt. SP said that cores had been taken so that he may be able to give some ideas, the big problem is that you disturb the material during coring. HC said that they take cores real late in the day. SP and JM agreed to discuss this issue again at some other time.

2. JM then presented the materials on the pump test. He said that the curves used to fit the data were for an infinitely leaking aquifer with instantaneous recharge. JM thinks that this is a result of a short circuit from the discharge line of the pump with discharged water falling from the surface to the pumped horizon (200') indicating that fractures are continuous from the surface to the pumped zone. GF said that he didn't feel it was a particularly good test because they only had three points to generate T and S from the Theis curve. T and S aren't the critical issue. The main problem was that they were unable to get a firm number on the vertical connection between the aquifers because of the fracturing. They could improve their chances by rerunning the test closer to the salt flats but this would require the construction of a new production well. Any new production well would be smaller than the one used for the test. Consequently, they may be unable to pump the well hard enough to stress the system enough to get a response in the observation wells. They need to talk with Ken Kippe in order to see how important that number will be in the computer model. They may be able to calculate a vertical conductivity number for use in the model by determining how big the number would have to be for pumping of the alluvial fan aquifer to cause the gradient from the salt flats toward the alluvial fan.

3. SP asked the U.S.G.S. what their understanding of the system at this time. GF said that they have only the work completed by Lines to rely upon and that there is a gradient from the Salt Flats to the alluvial fan but we don't know how the brine aquifer is connected with alluvial fan aquifer. However, the assumption is that this gradient is caused by the pumping of the alluvial fan wells.

4. CF asked what U.S.G.S. felt were their options. GF said that they could spend \$20,000 on a retest but they wouldn't be able to pump at 500 gpm on a new well. The well used in the first test was perforated for at least 65 feet. The \$20,000 estimate was based on using 8" casing with 20 to 30 feet of screen which would yield only 120 to 150 gallons per minute. This won't give enough stress to see any effect. To construct the right well you might need a 200 foot well screened for 100 feet with a good sand pack. This well could be much more expensive than the \$20,000 assumed. So GF felt that the best option was to simulate the values. JG asked if they

had good production records from the alluvial fan wells. GF answered no. DN asked if they had the computer modeling far enough along to get a sense of how sensitive the computer model would be to the values generated by the pump test. JM answered that it was not but that Ken Kippe had been out the first week of August and they had talked about the construction of a new well for a retest. CF asked if they were to redo the pump test when would the work be done. JM said that because of the schedule of the drillers they would need to do the test this fall if a new production well were to be constructed. If they were to use the existing production well they could defer the test until next spring. CF asked if Ken Kippe had enough data to be able to advise on the options about the pump test. JM said that is going to depend on how the model is configured. He said that the money might be better spent on shallow wells (50-75 feet) to look at the vertical connection at several locations. There may also be other areas where better data could be useful.

5. CF asked if the U.S.G.S. if there is a current vision of what the final computer model would look like. JM stated that it would be based on the density of the data. There are many more sample points in the shallow aquifer than there are deeper down. There is a question of how to model with such sparse vertical data. Ken Kippe says that the final model will evolve from preliminary runs. The primary concerns are what will be happening in the shallow brine system, basically what goes in and what comes out. We also need to look at the interaction between the ditch and the shallow brine system. The model will become more complex as more data are collected.

6. CF if you are collecting additional data to assist in the model effort, my gut feeling is that chemical data from the shallow wells will tell more about the system than only head differences. These are long term processes and chemical tracers may be the best vehicle to give us information about these long term processes.

7. JM said that U.S.G.S. is looking at chemistry and Blair Jones is quite interested in this aspect of the system. We have been out there trying to get below the shallow aquifer. There is a hard zone at about 20 feet and the WRD auger can get through the hard zone and get to plastic fluid clay beneath it, but it squeezes shut before they can get casing in the hole. The WRD auger can't then complete a well below the hard zone. They wanted to get a vertical head distribution on each line of wells on several cross sections through the Salt Flats aquifer. They put in three holes above the hard zone but were unable to go below 25 feet. CF asked if they knew the composition of the hard zone. JM answered that they thought it was hard clay but didn't know for sure. PA asked how many holes encountered this zone. JM answered that only the two they tried last week. They haven't noticed it in other areas because they haven't drilled this deep in other places except with a much larger rig that would not be slowed down by this zone.

8. PA asked if there was consensus in U.S.G.S. on what to do about

the pump test. JM said that they had been talking about it but the inclination was not to redo the test unless 1) 200 gpm will give a response in the observation wells or 2) they would be able to get better production from the pumped well. They are still waiting to here from the modeling person. GF said that it depends on what Ken Kippe thinks he needs for the model. They have considered retesting at the original production well but the secondary permeability of the system is so great that they don't think they will get any better data. For the amount of money, you are likely to get a lot more information if you drill several holes in various locations to collect data on head differences. The aquifer test is just one point so you get more information for your dollar from several shallow holes. CF recommended that chemical data be collected as well. GF said that the chemical data will cost about \$500 per location. JM said that the Denver driller will now be more expensive because the project that had been splitting the mobilization costs with them does not need any additional drilling.

9. CF asked how long it takes for them to get results back from the lab. JM said that the lab in Reston will turn data around in 6 weeks for major ions but that it takes up to 6 months to get isotope data.

10. JM said that they were detailing in a guy from Arizona to help catch up on the data collection. One of the employees assigned to the project has needed to take a large amount of sick leave this summer. Also, samples for chemical analysis have to be to Reston before the end of the fiscal year.

11. SP then asked about the status of the additional wells that had been planned for the median in I-80. JM said that they planned to hand auger those wells in the next 2 to 3 weeks.

12. PA asked if the U.S.G.S. felt they had any budget problems; if they needed the \$20,000 for the retest they could find it? JM said that they had budgeted money for the pond migration study but that they no longer feel that air photos will be effective. The money that they had budgeted for this they were going to try and carry over into next FY. JM said he thought satellite imagery could be more effective than air photos and that the money for photos could be diverted to additional drilling. GF stated that satellite images may be more expensive than air photos. PhA stated that he would follow up with DSC on satellite data. JK said that the TRC needs to look closely at the satellite package so that we don't develop unreasonable expectations.

13. JM said that he felt conditions were different this year. His impression was that Reilly didn't pump the ditch this winter as they had in years past. They started pumping in March or April.

14. CF then commented on the computer modeling. He said that it appeared that there were two models being proposed. One was a three Dimensional model and the other was a vertical cross section model. The very large aspect ratio (16 feet vertical:25 miles

horizontal) was noted. CF asked what they were trying to identify with the model. JM said that unless they have more data at depth there won't be much that the model can tell us. Several wells would be needed to deal with depth or so many assumptions will need to be made that you end up with only a sensitivity analysis. CF asked why they picked an impermeable boundary at 25 feet. JM stated that that was just an assumption so that modeling could be started. Also, they have only one vertical data point in the salt crust. CF then asked why a three dimensional model was used rather than a single layer aquifer model. JM said that he thought it was because of the way the ditches were handled in the model. LC said that one of the assumptions is the salt is transported in solution. The use of the three dimensional model is more effective at modelling the transport of salt than is a single layer model. JM said that Kippe's model is basically a node centered flow model so three dimensional space is actually three layers of nodes. This is much different from a cell based model, but it does function as a single layer model. GF said that they hadn't seen large differences in density vertically in the shallow aquifer.

15. PA pointed out that there has been a lot of discussion about the pump test trying to understand the vertical permeability; however, in the models we assume an impermeable base, why is this? GF said that they were really looking at the boundary between the alluvial fan aquifer and the shallow brine aquifer. There is a vertical component to this but they can handle the boundary in the model as a horizontal connection.

16. JM stated that in the observation wells used in the pump test they noted differences in water density vertically. He suggested that this may indicate that there is a tongue of high density fluids moving laterally at depth. His sense of this motion is from the salt flats toward the alluvial fan.

17. CF asked about the timing of any additional drilling. JM said that Singer's crew from Denver was tentatively scheduled for late September, so the decision point on additional drilling is soon. If they miss September than they can test again at the original production well. Their other option is to bring in Rogers to drill additional holes (50-75 feet deep). This would have to be done before mid-October or they would have to wait until next June or July of 93. JG asked if they could just rerun the pump test to capture the data lost in the storm. GF said that if you could divert the water into the ditch you might get better results but that this would require a minimum of a 2,000 foot long discharge line. The friction losses in the discharge line could reduce the discharge rate to as little as 800 gpm which may be too little to generate a response in the observation wells. SP said that the mine normally pumped their wells into a ditch. Was this feasible here? JM said that for the mine's wells this was fine, but the nearby ditch had filled in. They would have to pump the water 2.5 miles in order to get to an open ditch.

18. SP asked if Reilly is getting a lot of short circuiting of

water when they pump? JM said that would depend on the relationship between the ditch and the water table. There may be both gaining and losing portions of the ditch. However, Turk's analysis did not show the kind of short circuiting that this test encountered.

19. CF asked if the U.S.G.S. was looking for feedback from the TRC on their options in regard to the pump test. JM said yes but only if the TRC has strong feelings about the issues presented. PA asked if they would be taking from other areas of the project for any of the options presented. JM said that for this FY the answer is yes but they expected that it would be balance in the coming FY. JM said that they would need input by next week in order for it to be considered because of the scheduling of the driller.

20. CF asked when the U.S.G.S. would be ready to make their next report. JM said that data will be available from sampling by the winter. He said that the potentiometric surface map would be available only after the BLM provided the additional survey data on the wells.

21. After some additional discussion it was agreed that the next meeting of the TRC would be held on November 3, 1992.

22. PA then presented the feasibility report for the Salt Laydown project as a point of discussion. The TRC had a presentation by Bingham Engineering concerning the salt laydown project. The TRC is interested in any comments that the U.S.G.S. may have regarding the report. JM stated that data collection is scheduled to continue through FY 93. Activities under the laydown project aren't scheduled to begin until the 93-94 winter so there should not be interference between the two efforts. The U.S.G.S. study won't resolve all the uncertainties about the salt flats. There may be issues the U.S.G.S. would like to look at but funding is set in time. There will be a desire to follow the study up with monitoring. PA said there is a need to develop effective monitoring for the salt laydown project as well. HC said that Reilly has an idea of how monitoring should be conducted and thought that Reilly would be responsible for it.

23. JM identified some issues to consider. Will the salt laydown project replace or fully compensate for the assumed salt loss that is occurring. Also, you are adding a sizable amount of water to the naturally occurring ponds in the winter. Will that water stay on the surface and evaporate or does it increase the head on the system and displace the existing groundwater into the sinks, essentially acting as a secondary recovery system for brines. TN suggested that the more likely short circuit may be subsurface to the south. GF asked if the filling of breaches in the Salduro dike be sufficient or will the additional head cause the material to flow through the subsurface into the Salduro loop. PA said that DN had to leave but left a note - the salt laydown project also proposes construction of a dike near Floating Island - will this effect the salt loss study? Is it reasonable to begin construction

before data collection is complete? JM said that putting the berm in could create a ditch which would allow brines to flow into some other place. If this happens than that will effect the hydraulics on the north end of the salt flats. PA said that they could build a berm without letting water flow into the production ditches. JM said that interruption of the system by the berm could cause a detriment. It is an unknown disruption to the natural system. The north end is the only area of flow to the salt crust at this time. The ditch could interrupt the last place where there is subsurface inflow into the system other than upwelling from deeper sources.

24. JG said that there was no component in the feasibility study to do a pilot scale study. CF said that had been discussed. He said that Bingham felt that a pilot study wouldn't be able to show responses in the system that were of concern to us.

25. HC said that there is still a need to deal with the access road. The removal of that road may solve a lot of problem. It presently is in the hands of Tooele County. This could happen before the laydown project is underway.

26. JM said that U.S.G.S. had other concerns about the laydown project. How would increased NaCl effect the salt surface. When it precipitates would it adhere? Also, would they be pumping the new alluvial fan wells at the same time as the existing wells. If so the difference between 4,500 gallons per minute and 10,000 gallons per minute could be significant? Could this increase cause a brine intrusion to the alluvial fan? If so, the pumped water would become more briny and not be as effective for use in the laydown project. We don't know if the brine would all evaporate and place salt on the surface or if it would infiltrate and effect the groundwater budget. We can't verify the simulation included with the feasibility report because the calculations aren't shown. It does look like a mass balance/routing kind of model, but it needs to be verified. Also, it looks like the chemical analysis of the alluvial fan wells was used to model the system. A more appropriate analysis would be the concentration at the booster pump right before it goes into the abandoned production pond. This would reflect the effect of any gains or losses to shallow ground water and the effect of evaporation. The report also assumed a leaky system of ditches, but they need to verify that the ditches aren't actually contributing.

27. TN asked if they planned to drill the additional production wells this winter. CF said that he thought that they were going to use existing wells if they could get the production that they needed. PA said that he thought that Bingham had said that Reilly was going to pump their existing wells year round using them for production in the summer and for salt laydown during the winter. He said that Brent indicated that the greatest risk would be controlling the salinity of the system, and the second was establishing the water supply.

28. PA said that he didn't think there were immediate answers to

questions raised by the U.S.G.S. but asked what they thought about the general concept. JM said that he felt that .4 inches of salt per year was idealistic. JG said that he was concerned that the laydown project would be accepted as the answer to the problems experienced at the Salt Flats but it would take so long to know if it worked that we could be a lot worse off by the time we determined it wasn't working.

29. JM said that he noticed that a new ditch south of I-80 had not been included on the map in the laydown study. SP said that it was under construction when the salt laydown study was being prepared. JM said that the new ditch would be the new southern boundary of their computer model. SP said that Glen Wadsworth would have more specifics about the ditch and when it was put into use.

30. JG said that he wanted to emphasize the need for systematic monitoring of the salt flats upon the completion of the salt loss study. This would be particularly important if something like the laydown project was underway.

At this time the main meeting came to an end (about 11:30 am).

Post Meeting

1. PA said that the timing on the next meeting and the modeling effort indicate that November would be early enough to for the next meeting. CF said that he would like for the potentiometric surface map and water quality data to be circulated before the next meeting. He would also like a summary from the U.S.G.S. on their current thinking on how the system works. The group agreed to tentatively schedule the next meeting for ~~October~~ ^{November} 3, 1992.

2. CF presented a motion. TRC needs to make statement about the 8" production well construction and follow through with the recommendation that modeling be used to guide the decision regarding the rerunning of the aquifer test. SP suggested that the recommendation be more general regarding more drilling before there are results of modeling to guide further data collection. TN suggested that it be made a more positive statement and endorse option 3 (drilling several shallow wells) unless/until modeling indicated a need to rerun the test. PA said that he liked the idea of completing several shallower holes with nested piezometers looking and vertical gradients. He felt a recommendation in this direction would also help with additional stratigraphic data.

3. CF presented the following language as a motion and the motion passed: "The TRC recommends that further decisions for pumping test will be based on the interpretation of modeling results."

4. PA presented the following language as a motion and the motion passed: "The TRC encourages the U.S.G.S. to pursue a program to drill several shallow (less than 100') holes and completed them with nested piezometers to gather information on vertical gradients in head and chemistry this fall.

5. CF presented the following language as a motion and it passed with JK abstaining: "The TRC as a group recommends that monitoring extend beyond the U.S.G.S. study. The BLM should consider in their budget planning the maintenance of monitoring beyond the end of the U.S.G.S. study."

6. CF then asked what statements needed to be made with regard to the Salt Laydown study. JK said that he was not ready at this time to give an unmitigated endorsement of the study. PA said that he thought the TRC could make a statement regarding the conceptual value of the study. If there was an opportunity to pass forward a conceptual endorsement of the project and that it was not in conflict with the U.S.G.S. salt loss study. TN said that the salt laydown project was within the realm of remedies that can be considered for the salt loss. CF said that they needed to get with Deane to find out what his expectations are from the TRC regarding this. Another meeting of the TRC will be required if a formal position from the TRC is needed.